Hi-C2.1 Observations of Solar Jetlets at Edges of Network Lanes

Navdeep K. Panesar[1], Alphonse C. Sterling[1], and Ronald L. Moore[1,2] + Hi-C Science Team

[1]NASA Marshall Space Flight Center, Huntsville, AL

[2]Center for Space Plasma and Aeronomic Research (CSPAR), UAH, Huntsville, AL

Abstract

We present high resolution (0.2”) high cadence (5s) extreme ultraviolet (EUV) observations of small-scale jetlet-like[1] features and spicule-like[2] features observed with NASA’s High-resolution Coronal Imager2.1 (Hi-C) during its 5-min observing span. We investigate the magnetic setting of 4 on-disk jetlets and 2 on-disk spicules by using high resolution 172A images from Hi-C and EUV images from Solar Dynamics Observatory (SDO)/Atmospheric Imaging Assembly (AIA) and line-of-sight magnetograms from SDO/Helioseismic and Magnetic Imager (HMI). The jetlets and spicules are at edges of magnetic network lanes. From magnetograms co-aligned with the Hi-C and AIA images, we find that the jetlets stem from sites of likely flux cancelation between merging majority-polarity and weaker minority-polarity flux, but in contrast to larger jetlets observed by IRIS some do not show obvious enhanced brightenings at their base. Based on the similarity of these observations of ~4 obvious Hi-C small jetlets with our previous observations of 10 IRIS larger jetlets and ~30 coronal jets in quiet regions and coronal holes, we infer that flux cancelation is probably the essential process in the buildup and triggering of jetlets. Our observations suggest that network jetlet eruptions, large and small, are small-scale analogs of both larger-scale coronal jet eruptions and the still-larger-scale eruptions that make major CMEs. [1,2]For simplicity we will use term jetlets for jetlet-like features and spicules for spicule-like features.

IRIS Jetlets (*Panesar et al 2018*)

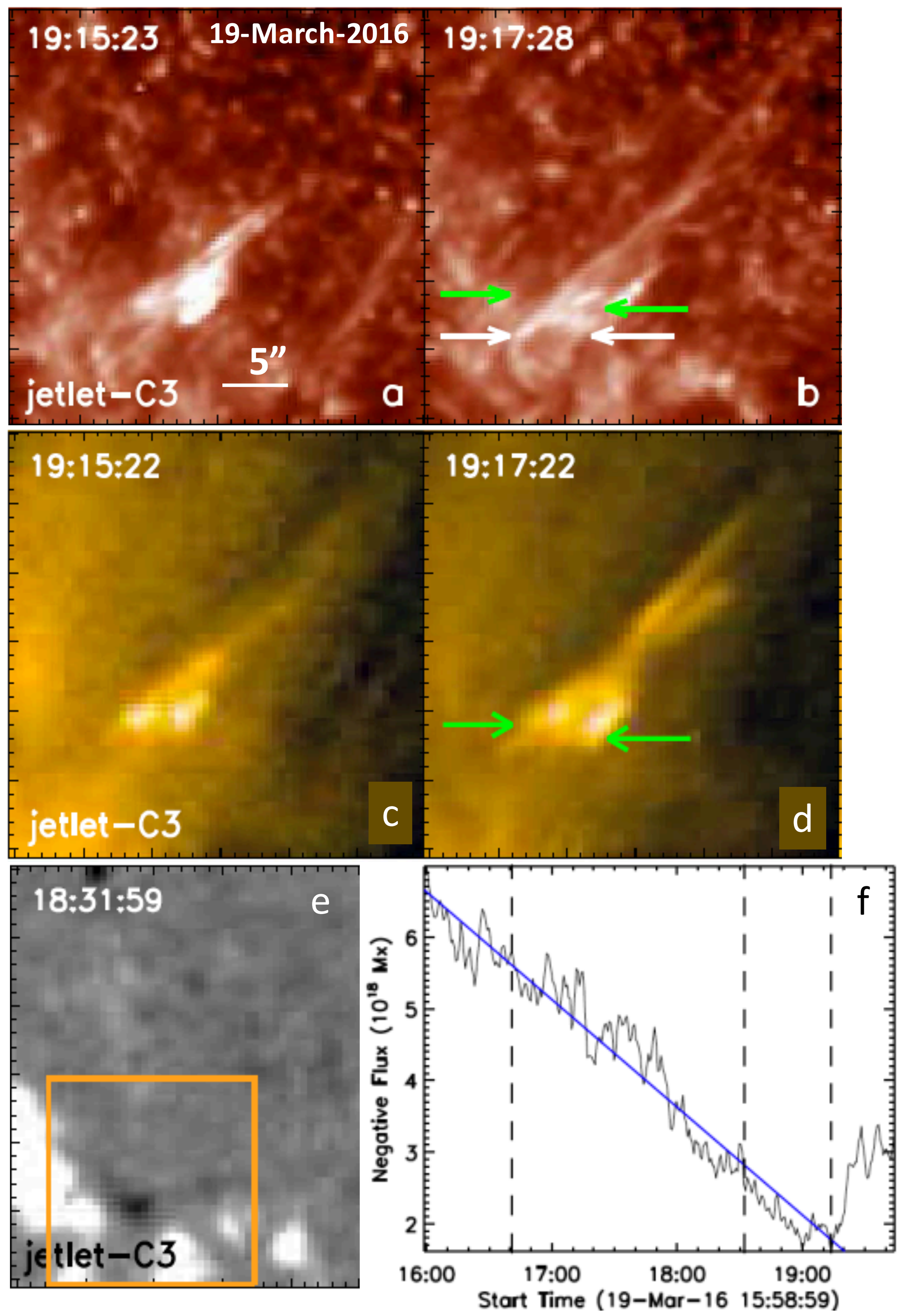


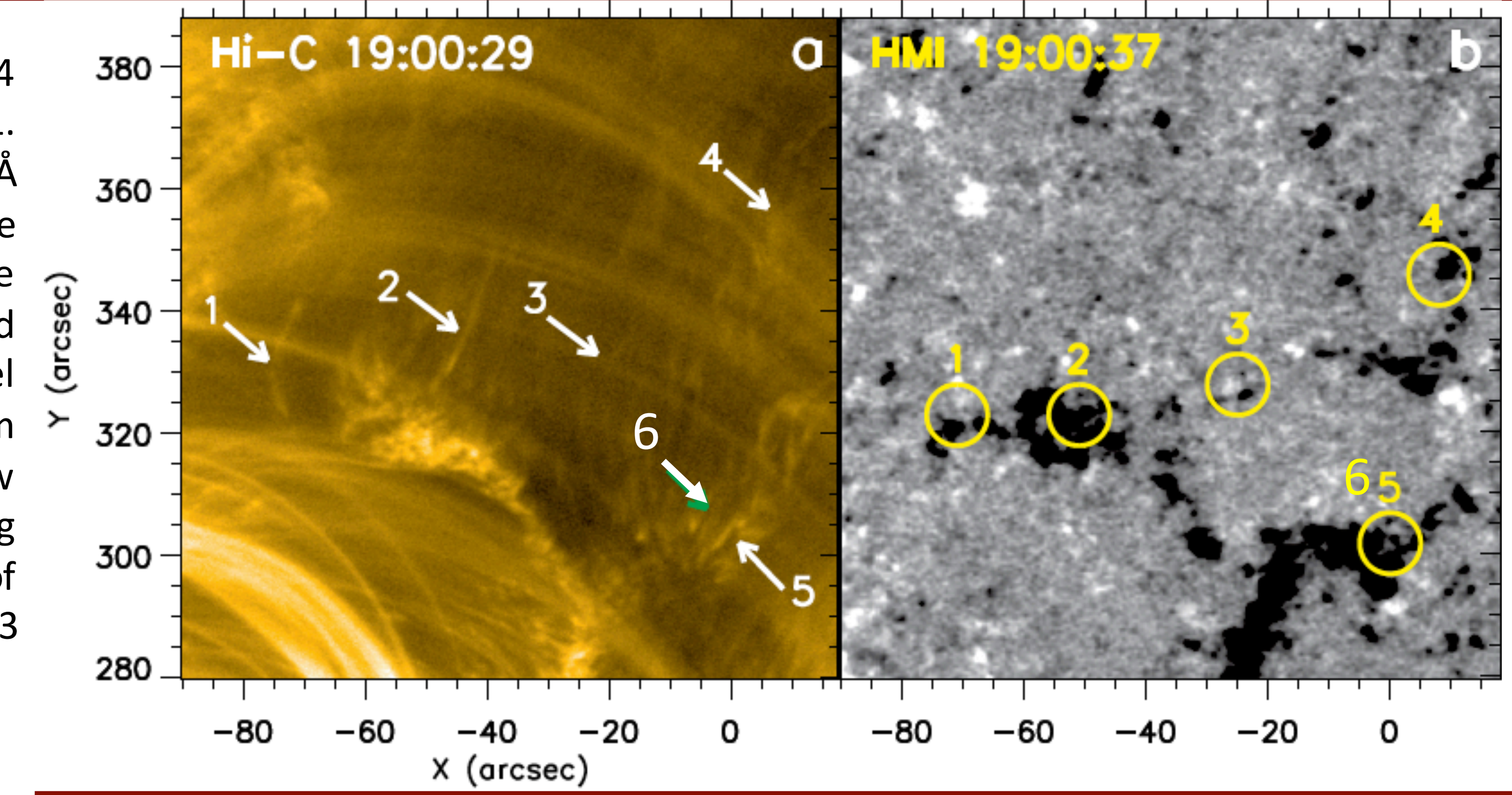
Fig 2. Panels (a) and (b) show the evolution of an IRIS Si IV jetlet. Panels (c) and (d) show AIA 171 Å images of the same jetlet. The white and green arrows respectively point to Si IV and 171 Å brightenings at the base of flare loops. Panel (e) shows the HMI magnetogram of the base of the jetlet. The orange box in (e) shows the region measured for the magnetic flux time plot in Fig. 1(f). Panel (f) shows the negative-flux decrease in the jetlet-base region over 4 hours, a clear indication of flux cancelation at the base of the jetlet. The dashed lines show the 3 jetlets onset times from the same neutral line. We infer that continuous flux cancelation over 6 hours prepares and triggers each of these sequential jetlets. The average flux cancelation rate is 1.7 X 10^{18} Mx hr^{-1} (Panesar et al. 2018).

Hi-C Small-scale Features – An Overview

Table 1. Measured parameters of observed jetlet-like and spicule-like features

Event[a] No.	Type[b]	Spire Length[c] (km)	Spire Width[d] (km)	Jetlet Speed[e] (km s^{-1})	Base[f] Brightenings	Discernible[g] Minority flux
1	jetlet-like	12000±800	750±50	110±30	No	No
2	jetlet-like	14000±300	600±100	24±3	No	No
3	jetlet-like[h]	9000±1000	750±100	115±20	Yes	Yes
4	jetlet-like	10000±650	650±50	110±25	Yes	Yes
5	spicule-like	5000±1000	400±50	14±5	No	No
6	spicule-like	6000±1000	350±50	50±10	Yes	No

Fig 2. Magnetic setting of the 4 jetlets and 2 spicule of Table1. Panel (a) shows an Hi-C 172 Å image of the quiet region. The white arrows in (a) point to the locations of the jetlets and spicules listed in Table 1. Panel (b) shows an HMI magnetogram of the same region. The yellow circles show the underlying magnetic field near the base of jetlets and spicules. Jetlets- 3 and 4 are not in panel (a).



Hi-C Jetlet-like Features

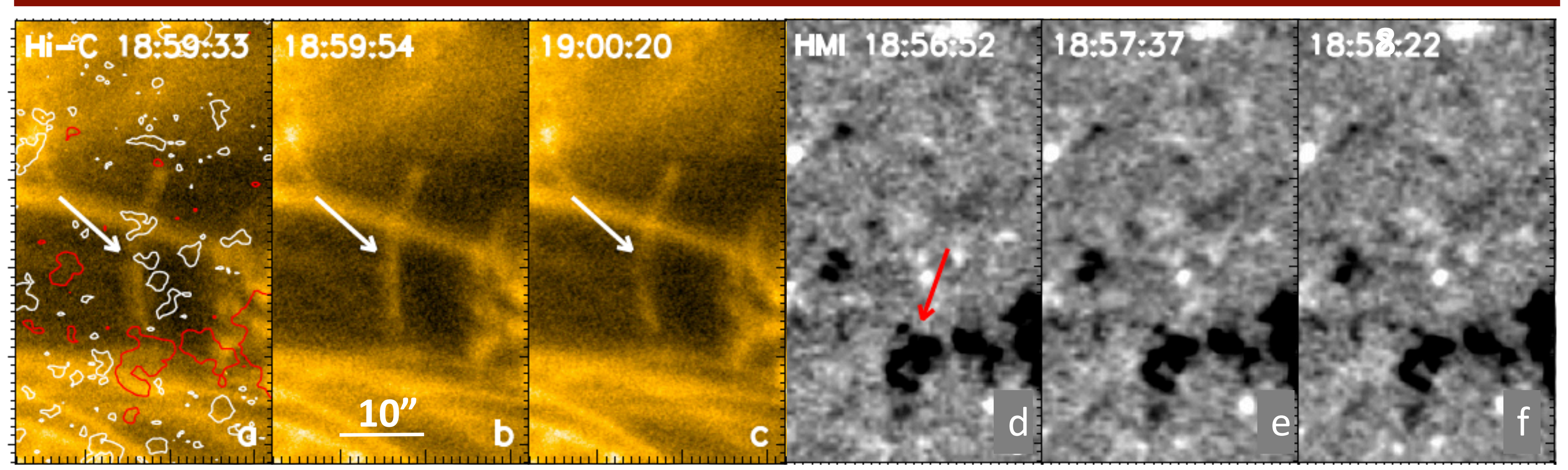
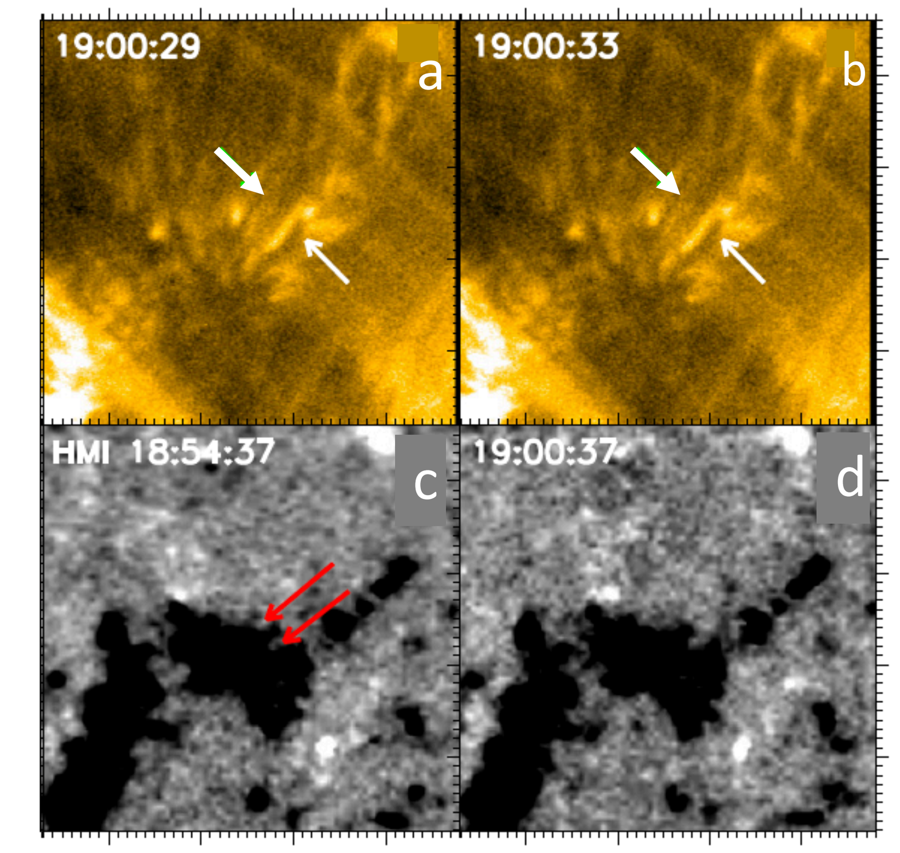


Fig 3. Jetlet-1 of Fig 2. Panels (a-c) show an Hi-C 172 Å image of the jetlet-1. The white arrows point to the jetlet. HMI contours of level ±50 G are overlaid onto panel (a). Panels (d-f) show the HMI magnetograms of the base of the same jetlet. The red arrow points to the base of the jetlet. The base is at the edge of the magnetic network lane between a majority-polarity (negative) and a merging weak minority-polarity flux patch (positive).

Hi-C Spicule-like Features

Fig 4. Spicules 5 and 6 of Fig. 2. Panels (a) and (b) show an Hi-C 172 Å image of the spicules-like features The white arrows point to the dark spicules. Panels (c) and (d) show the HMI magnetograms of the base of the same features. The red arrows point to the bases of the spicules. The bases are at the edge of a magnetic network lane flux patch.



Discussion and Interpretation

- We examine the magnetic setting of 6 small-scale jets (features that are smaller than coronal jets) and measure their speed and size using Hi-C 2.1 data and SDO data.
- Using Hi-C images, we identified 4 jetlet-like features and 2 spicule-like features within the Hi-C field of view.
- Co-aligned HMI magnetograms show that all six of these jetlets stem from the edges of magnetic network lanes, some from between a majority-polarity flux patch and a discernible merging weak minority-polarity flux patch.
- Using Hi-C images, we measured that the spire length, spire width and spire speed of the 4 network jetlets have mean values of 8900 ± 3900 km, 500 ± 150 km and 75 ± 50 kms^{-1}. The length, width and speeds of the 2 spicules have mean values of 5500 ± 700 km, 375 ± 35 km and 30 ± 25 kms^{-1}.
- The Hi-C jetlets, on average, are at least six times smaller in spire length and three times smaller in spire width than the spire length (27,000 ± 8000 km) and spire width (3200 ± 200 km) of the IRIS EUV jetlets (an example is shown in Fig. 1; Panesar et al 2018), and the observed spicule widths are similar to spicule widths (400 km) of Sterling 2000 and De Pontieu et al 2007.
- Our observation of 4 jetlets and 2 spicules show that they stem from the edges of magnetic flux lanes. Therefore they are plausibly small-scale versions of the larger coronal jets and of still-larger CME events.

References

- De Pontieu, B., McIntosh, S., Hansteen, V. H., et al. 2007, PASJ, 59, 655.
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